G7:Open and Results

Dynamics of Meteor Trails Deposited in the Equatorial Electrojet

Elaine Chapin
Jet Propulsion Laboratary
4800 Oak Grove Drive
Pasadena, CA 91109-8099 USA
Phone: (8 8 354-)497, Fax: (818)393-5285, e-mail: elaine.chapin@j pl.nasa.gov

Erhan Kudeki
Department of Electrical Engineering
University of Illinois
Urbana, IL 61801 USA
Phone: (2 7)333-4153, Fax: (217)244-5624, e-mail: e-kudeki@uiuc.edu

Abstract

Previously we have reported that the meteor echoes detected at the Jicamarca Radio Observatory exhibit some unusual properties [1]. In summary, the echo durations are very long (~2 s to 3 min), radio wave scattering is non-specular (echoes are detected simultaneously over a ~10-15 km altitude range centered about 97 km), and the Doppler spectra of the scattered signals contain components red shifted by as much as ~400 m/s immediately after the onset of the echoes. Additional observations have indicated that the direction of the high-frequency spectral components of the meteor returns is controlled by the direction of the zonal electric field component at E region altitudes [2]. To explain these observations we suggested that meteor trails deposited within the equatorial electrojet constitute transient current paths and that intense currents that flow through the trails excite short-scale plasma waves that scatter the probing radio waves. The direction of the current, controlled by the zonal electric field direction, determines the propagation direction of the unstable waves detected by the Jicamarca radar.

In this work, The polarization mechanism driving the transient current is described in three-dimensions, including the electrodynamics along the geomagnetic field lines. One repercussion of the high conductivity field lines is the decrease in the polarization electric field inside the meteor due to E region loading. We discuss the three-dimensional structure of the transient current system as elucidated by numerical simulations and the implications of the mechanism we propose regarding the motion of the meteor trail. We conclude with a review of our experimental meteor drift observations and a comparison of them with the neutral wind and the electron drift velocities.

References

[1] Chapin and Kudeki, J. Geophys. Res., **99**, 8937-8949, 1994.
[2] Chapin and Kudeki, Geophys. Res. Lett., **21**, 2433-2436, 1994.